

A SIMPLE DEVICE FOR TEACHING CAUSAL CONCEPTS

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Background and Aims: We present a simple device for teaching causal concepts in epidemiology. Originally developed for a lay audience, it has proven to be illuminating for graduate students also.

Methods: We use a simple, non-health example so that: (1) “truth” is known, and (2) the conditions that cause valid and invalid results can be easily understood. Let the total study group consist of 4 flashlights. The question we ask is, “Does moving the switch from the ‘off’ position to the ‘on’ position cause a flashlight to light?” We know that the simultaneous occurrence of the following conditions is sufficient to produce light in a flashlight (when switched “on”): (1) good battery; (2) good bulb; (3) unbroken circuit from switch to battery to bulb to switch; and (4) good switch. Let one of the flashlights have all four of these component causes in place; let the other three be missing one or two of these component causes. We vary the definition of the target population to illustrate different concepts.

Results: We show how, with this device, it is easy to illustrate the following: what is a causal contrast; the importance of the target population in causal inference; what is effect-measure modification; counterfactuals; that confounding results from imperfect substitution for a counterfactual outcome frequency; and the combined impact of confounding, selection errors and measurement errors on study results. In addition, we show with this device the following, which some find surprising: an observed effect measure can be simultaneously confounded and unconfounded, matching on causal factors does not guarantee that confounding is absent, absence of perfect matching on causal factors does not guarantee that confounding is present, and in some situations it appears that a DAG can give the wrong indication about the presence of confounding.